5.11.1.2.3 Storage – CWC

No new storage would be needed at the CWC under Alternative Group A; therefore, no new construction would be required. Operations would continue at existing levels during the near-term, possibly increasing then declining as completion of waste processing is approached.

Radiological Consequences. Six accident scenarios involving radioactive material at the CWC were evaluated as part of the Interim Safety Basis (Vail 2001a). These accidents were a handling/forklift-caused drum failure, a drum-handling fire, a flammable gas explosion, a truck impact and fire, a design-basis earthquake, and a beyond-design-basis earthquake. They were selected for analysis using a hazard identification and assessment process and have estimated annual frequencies of occurrence ranging from 0.11 per year to 4E-06 per year, categorized as Anticipated and Extremely Unlikely, respectively. Accident consequences shown in terms of radiation dose and potential LCFs are presented in Table 5.34.

The largest consequences to the offsite MEI would be from a beyond-design-basis earthquake. This MEI would receive a dose of about 13 rem and have a 8E-03 probability of an LCF. This accident would also result in the largest consequences to the population. About 30 LCFs would be expected. LCFs in the population would be expected for all analyzed accidents except a handling/forklift drum failure.

The largest consequences to a non-involved worker would be from the truck impact and fire and the beyond-design-basis earthquake accidents. The non-involved worker would receive a dose of about 4900 rem and 5900 rem, respectively. Both of these doses would likely result in a fatality.

Table 5.34. Radiological Consequences of Accidents at the CWC

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[a]	Dose (person-rem)	Number of LCFs[b]	Dose (rem)	Prob. LCF[a]
Handling/Forklift Drum Failure	1.1E-01	0.0026	2E-06	11.5	0 (7E-03)	1.2	0.0007
Drum Handling Fire	1.1E-04	0.7	4E-04	3000	2	310	0.2
Flammable Gas Explosion	4.2E-04	1.0	6E-04	4300	3	460	0.3
Truck Impact and Fire	4.0E-06	11.0	6E-03	47,000	30	4900	(d)
Design-Basis Earthquake	3.3E-03	1.1	6E-04	4700	3	480	0.3
Beyond-Design-Basis Earthquake	(c)	13	8E-03	56,000	30	5900	(d)

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.
(c) Not quantified in reference but frequency less than design-basis earthquake.
(d) This accident would likely result in a fatality.

Non-Radiological (Chemical) Consequences. Given that MLLW is also stored in the CWC, non-radioactive hazardous materials may be involved in the same accident scenarios as radioactive materials. The radiological accident analysis determined that two accidents having the largest consequences are the flammable gas explosion and the truck impact and fire accidents. Potential non-radiological consequences of these two accident scenarios were assumed in the safety analysis (Vail 2001a) to provide a reasonable upper limit for all accidents. Accident consequences are presented in Table 5.35, which shows the ratio of estimated concentrations to TEEL values. A value less than 1 indicates an acceptable condition. A blank ratio in the table indicates a more restrictive TEEL level was previously met (for example, the ratio was less than 1) and evaluation of higher TEEL-level ratios is unnecessary.

The air concentration at the location of the offsite MEI would be well below the TEEL/ERPG-1 level for all chemicals except beryllium. The air concentration at the location of the MEI would exceed the TEEL/ERPG-1 level beryllium because of the truck impact and fire accident. A hypothetically exposed individual would not be expected to experience or develop irreversible or other serious health effects or symptoms that might impair his or her ability to take protective action. No impacts would be expected.

For the onsite non-involved worker, the TEEL/ERPG-3 level might be exceeded for beryllium for both of these accidents. This individual may experience or develop a life-threatening effect. TEEL/ERPG-2 levels might also be exceeded for mercury, lead, potassium hydroxide, phosphoric acid, and sodium hydroxide. An individual might experience or develop irreversible or other serious health effects or symptoms that might impair his or her ability to take protective action. The TEEL/ERPG-1 levels might also be exceeded for cadmium, nitric acid, and hydrofluoric acid.

Like the radiological consequences to involved workers, non-radiological consequences could be highly variable—ranging from no exposure to high concentrations of chemicals—depending upon whether or not a worker were directly in the plume of immediately released material, and for how long.

Industrial Accidents-Construction. No new construction would take place at the CWC under Alternative Group A, and no industrial accidents from construction would occur.

Industrial Accidents-Operations. Direct operations staffing in the CWC would total 3200 worker-years. Estimated health and safety impacts would be 85 total recordable cases, 36 lost workday cases, and 1200 lost workdays.

Table 5.35. Non-Radiological Air Concentrations for Accidents at the CWC

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Drum Explosion											
Ammonium fluoride	1.0E+00	2.3E-03	2.5	2.5	40	4.2E-01			9.3E-04		
Ammonium nitrate	1.0E+00	2.3E-03	10	10	500	1.0E-01			2.3E-04		
Ammonium sulfate	2.1E+00	4.5E-03	125	500	500	1.7E-02			3.6E-05		
Beryllium	7.7E-01	1.6E-03	0.005	0.025	0.1	1.5E+02	3.1E+01	7.7E+00	3.3E-01		
Carbon tetrachloride	4.9E+00	1.1E-02	125	600	4000	4.0E-02	8.2E-03		8.5E-05		
Hydrofluoric acid	7.0E+00	1.5E-02	1.5	15	40	4.7E+00	4.7E-01		1.0E-02		
Nitric acid	8.2E+00	1.7E-02	2.5	12.5	50	3.3E+00	6.5E-01		7.0E-03		
Phosphoric acid	7.0E+00	1.5E-02	3	5	500	2.3E+00	1.4E+00	1.4E-02	5.2E-03		
Potassium hydroxide	7.5E+00	1.6E-02	2	2	150	3.8E+00	3.8E+00	5.0E-02	8.2E-03		
Sodium hydroxide	1.0E+01	2.1E-01	0.5	5	50	2.1E+01	2.1E+00	2.1E-01	4.3E-01		
Sulfuric acid	4.4E-01	9.7E-04	2	10	30	2.2E-01			4.8E-04		
Truck Impact and Fire											
Ammonium fluoride	3.5E-01	7.4E-04	2.5	2.5	40	1.4E-01			3.0E-04		
Ammonium nitrate	3.5E-01	7.4E-04	10	10	500	3.5E-02			7.4E-05		
Ammonium sulfate	6.8E-01	1.4E-03	125	500	500	5.4E-03			1.2E-05		
Beryllium	6.0E+00	1.4E-02	0.005	0.025	0.1	1.2E+03	2.4E+02	6.0E+01	2.7E+00	5.4E-01	
Carbon tetrachloride	1.6E+00	3.5E-03	125	600	4000	1.2E-02			2.8E-05		
Hydrofluoric acid	2.3E+00	4.9E-03	1.5	15	40	1.5E+00	1.5E-01		2.5E-03		
Nitric acid	1.0E+01	2.1E-02	2.5	12.5	50	4.2E+00	8.3E-01		8.5E-03		
Phosphoric acid	2.3E+00	4.9E-03	3	5	500	7.5E-01			1.6E-03		
Potassium hydroxide	2.4E+00	5.3E-03	2	2	150	1.2E+00	1.2E+00	1.6E-02	2.7E-03		
Sodium hydroxide	1.4E+01	3.0E-02	0.5	5	50	2.8E+01	2.8E+00	2.8E-01	6.0E-02		
Sulfuric acid	1.4E-01	3.1E-04	2	10	30	6.9E-02			1.5E-04		
Mercury	1.7E+00	3.8E-03	0.025	0.1	10	6.9E+01	1.7E+01	1.7E-01	3.8E-02		
Cadmium	1.7E+00	3.8E-03	0.03	4	9	5.8E+01	4.3E-01		1.3E-01		
Polychlorinated biphenyls (PCBs)	3.5E-01	7.5E-04	3	5	5	1.2E-01	6.9E-02		2.5E-04		
Lead	1.7E+00	3.8E-03	0.15	0.25	100	1.2E+01	6.9E+00	1.7E-02	2.5E-02		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

5.11.1.2.3.1 Treatment – Waste Receiving and Processing Facility

Radiological Consequences. Seven accident scenarios involving radioactive material at the WRAP were evaluated in the WRAP Final Safety Analysis Report (Tomaszewski 2001). These accident scenarios were a handling/forklift drum failure, a drum handling fire, a container handling explosion, a fire in a process enclosure (glovebox), an explosion in process enclosure (glovebox), design-basis earthquake, and beyond-design-basis earthquake. These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence are described qualitatively and quantitatively. The frequencies of occurrence range from anticipated (with an associated annual frequency range of 1 to 0.01) to a much lower frequency for the beyond-design-basis earthquake. Accident consequences, shown in terms of radiation dose and potential LCF, are presented in Table 5.36.

The largest consequences to the MEI would be from a beyond-design-basis earthquake. The MEI would receive a dose of about 1.1 rem and have a 7E-04 probability of an LCF. Six of the seven accidents examined would result in one to three LCFs in the population.

The largest consequences to a non-involved worker would be from a beyond-design-basis earthquake. The non-involved worker would receive a dose of about 500 rem and have a 0.3 probability of an LCF.

Table 5.36. Radiological Consequences of Accidents at WRAP

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Handling/Forklift Drum Failure	Anticipated [(c)]	0.0014	8E-07	6.0	0 (0.003)	0.6	0.0003
Drum Handling Fire	2×10^{-3}	0.31	2E-04	1400	1 (0.8)	140	0.09
Container Handling Explosion	3×10^{-3}	0.74	5E-04	3300	2	340	0.2
Process Enclosure Fire	2×10^{-3}	0.20	1E-04	900	1 (0.5)	100	0.06
Process Enclosure Explosion	3×10^{-3}	0.67	4E-04	2900	2	300	0.2
Design-Basis Earthquake	1×10^{-3}	0.92	6E-04	4100	2	420	0.3
Beyond-Design-Basis Earthquake	[(c)]	1.1	7E-04	4800	3	500	0.3

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.
(c) Not quantified in reference.

Non-Radiological (Chemical) Consequences. Because MLLW would also be handled at the WRAP, non-radioactive hazardous materials may be involved in accidents. A process enclosure fire was evaluated for non-radiological consequences. The accident scenario for this analysis is the same as

evaluated for radiological consequences of the process enclosure fire, where containers rupture and burn. A fire in the process enclosure is postulated due to the mixing of incompatible materials or damage to the packaging of pyrophoric material that allows ignition to take place. Because no mitigation credit is taken for the process enclosure, the consequence of this event is greater than any container fire at the WRAP. Accident consequences are presented in Table 5.37.

The air concentration at the location of the offsite MEI could exceed the TEEL/ERPG-1 level for beryllium, cadmium, and mercury. Hypothetically exposed individuals would not be expected to experience or develop irreversible or other serious health effects or symptoms that might impair their ability to take protective action.

For the onsite, non-involved worker, the TEEL/ERPG-3 level might be exceeded for beryllium, cadmium, mercury, and sodium oxide. This hypothetically exposed individual might experience or develop a life-threatening effect. The TEEL/ERPG-2 level could also be exceeded for uranyl nitrate hexahydrate, nitric acid, phosphoric acid, sodium, sodium hydroxide, and naphthylamine tritium. No other chemical would exceed the TEEL/ERPG-1 levels; therefore, no serious health effects or symptoms would be expected.

Like the radiological consequences to involved workers, non-radiological consequences could be highly variable—ranging from no exposure to high concentrations of chemicals—depending upon whether or not a worker were directly in the plume of immediately released material, and for how long.

Industrial Accidents. Direct operations staffing in the WRAP would total 1800 worker-years. Estimated health and safety impacts would be 48 total recordable cases, 20 lost workday cases, and 710 lost workdays.

Table 5.37. Non-Radiological Air Concentrations for a Process Enclosure Fire Accident at WRAP

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Ammonia	3.9E-01	8.5E-04	15	100	500	2.6E-02			5.7E-05		
Ammonium nitrate	6.9E+00	1.5E-02	10	10	500	6.9E-01			1.5E-03		
Beryllium	6.1E+00	1.3E-02	0.005	0.025	0.1	1.2E+03	2.4E+02	6.1E+01	2.7E+00	5.3E-01	
Butyl alcohol	7.0E-01	1.5E-03	150	150	4000	4.7E-03			1.0E-05		
Cadmium	7.8E+01	1.7E-01	0.03	4	9	2.6E+03	2.0E+01	8.7E+00	5.7E+00	4.3E-02	
Carbon tetrachloride	1.3E+01	2.9E-02	125	600	4000	1.1E-01			2.3E-04		
Cyclohexane	3.3E+00	7.1E-03	3000	4000	4000	1.1E-03			2.4E-06		
Dichloroethane	1.0E+00	2.2E-03	7.5	200	200	1.4E-01			2.9E-04		
Dioxane	2.2E+01	4.8E-02	75	350	1500	2.9E-01			6.3E-04		
Ethyl acetate (acetic ether)	7.8E-01	1.7E-03	1500	1500	7500	5.2E-04			1.1E-06		
Hydrogen peroxide	4.4E-01	9.5E-04	12.5	60	125	3.5E-02			7.6E-05		
Indole-2-C14 picrate	8.6E-05	1.9E-07	0.3	0.5	10	2.9E-04			6.2E-07		
Manganese	5.2E-02	1.1E-04	3	5	500	1.7E-02			3.8E-05		
Mercury	3.8E+01	8.3E-02	0.025	0.1	10	1.5E+03	3.8E+02	3.8E+00	3.3E+00		
Methanol	1.1E+00	2.4E-03	250	1250	6000	4.4E-03			9.5E-06		
Napthylamine tritium	8.6E+01	1.9E-01	7.5	50	300	1.1E+01	1.7E+00	2.9E-01	2.5E-02		
Nitric acid	3.0E+01	6.6E-02	2.5	12.5	50	1.2E+01	2.4E+00	6.1E-01	2.7E-02		
Phosphoric acid	4.4E+01	9.5E-02	3	5	500	1.5E+01	8.7E+00	8.7E-02	3.2E-02		
Propane	7.8E-01	1.7E-03	3500	3500	3500	2.2E-04			4.9E-07		
Sodium	2.3E+00	4.9E-03	2	2	10	1.1E+00			2.5E-03		
Sodium hydroxide	3.2E+01	7.0E-02	0.5	5	50	6.4E+01	6.4E+00	6.4E-01	1.4E-01		
Sodium hypochlorite	6.5E-03	1.4E-05	75	500	500	8.6E-05			1.9E-07		
Sodium oxide	4.1E+01	9.0E-02	10	10	10	4.1E+00	4.1E+00	4.1E+00	9.0E-03		
Styrene	2.4E+00	5.3E-03	200	1000	4000	1.2E-02			2.6E-05		
Tetrahydrofuran	1.2E+00	2.7E-03	750	3000	6000	1.7E-03			3.6E-06		
Tetralin	8.6E-05	1.9E-07	NA	NA	NA						
Toluene	7.6E-01	1.6E-03	150	1000	3500	5.0E-03			1.1E-05		
Uranyl nitrate hexahydrate	5.3E+00	1.2E-02	0.6	0.6	10	8.8E+00	8.8E+00	5.3E-01	1.9E-02		
Vinyl acetate	2.4E+00	5.3E-03	150	250	1500	1.6E-02			3.5E-05		
Vinyl chloride	3.6E+00	7.8E-03	12.5	12.5	200	2.9E-01			6.3E-04		
Zirconium	7.5E-01	1.6E-03	10	10	50	7.5E-02			1.6E-04		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

5.11.1.2.3.2 Treatment – Modified T Plant Complex

Radiological Consequences – Continuing T Plant Activities. Six accident scenarios involving current activities and radioactive material at T Plant were evaluated as part of the Interim Safety Basis (Bushore 1999, 2001). These accidents were a spray release in the 221-T canyon, railcar spill in the 221-T rail tunnel, filter fire in the 2706-T facility, LLW drum storage fire in the 214-T building, filter bank fire in the 219-T building, and seismic event.

These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence are described qualitatively and quantitatively. The frequencies of occurrence range from less than 1.E-02 to 1.9E-05 for the 291-T filter bank fire, categorized as unlikely and extremely unlikely, respectively (see Appendix F, Section F.2.2). Accident consequences, shown in terms of radiation dose and potential LCF, are presented in Table 5.38.

Table 5.38. Radiological Consequences of Accidents at the Modified T Plant Complex for Continuing T Plant Activities

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Spray Release, 221-T Canyon	2E-05	0.31	2E-04	2100	1	220	1E-01
Railcar Spill, 221-T Rail Tunnel	< 0.01 [(c)]	0.10	6E-05	650	0 (0.4)	68	4E-02
2706-T Outdoor Drum Fire	1E-03 to 2.5E-04 [(c)]	0.70	4E-04	4800	3	500	3E-01
214-T LLW Drum Storage Fire	< 0.01 [(c)]	0.15	9E-05	1000	1 (0.6)	110	7E-02
291-T Filter Bank Fire	1.9E-05	0.02	1E-05	140	0 (0.08)	15	9E-03
Seismic Event	[(c, d)]	0.27	2E-04	1900	1	190	1E-01

(a) Prob. LCF = the probably of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than one fatality estimated.
(c) These less quantitative frequencies are also from (Bushore 2001).
(d) For a design-basis earthquake, an annual frequency would be about 1×10^{-3} or less.

The largest consequences to the MEI would be from an outdoor drum handling accident with fire at the 2706-T facility. The MEI would receive a dose of about 0.70 rem and have a 4E-04 probability of an LCF. Within the population, this accident would result in three LCFs, and three of the other accidents examined would result in one LCF.

The largest consequences to a non-involved worker would also be from an outdoor drum handling accident with fire at the 2706-T facility. The non-involved worker would receive a dose of about 500 rem and have a 3E-01 probability of an LCF.

Radiological Consequences – New Waste Processing Facility. Four accidents for the proposed new waste processing facility in the modified T Plant Complex were evaluated, based upon the analysis and results of the preliminary safety evaluation for the WRAP Module 2 (WHC 1991). These accidents were a filtered box drop, an unfiltered box drop, a design-basis earthquake with fire, and a tank farm pump spill. These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence range from anticipated (with an annual frequency range of 1 to 0.01) to an extremely unlikely accident (with an annual frequency range of 1E-04 to 1E-06). Accident consequences, shown in terms of radiation dose and potential LCFs, are presented in Table 5.39.

The largest consequences to the MEI would be from a design-basis earthquake and fire. The MEI would receive a dose of about 0.31 rem and have a 2E-04 probability of an LCF. This accident also results in the largest consequences to the population, but no LCFs would be expected.

The largest consequences to a non-involved worker would also be from a design-basis earthquake and fire. The non-involved worker would receive a dose of about 77 rem and have a 5E-02 probability of an LCF.

Table 5.39. Radiological Consequences of Accidents for the Modified T Plant Complex with the New Waste Processing Facility

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person-rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Box Drop (filtered)	1E-02	8.9E-05	5E-08	0.21	0 (1E-04)	2.2E-02	1E-05
Box Drop (unfiltered)	1E-02	1.8E-01	1E-04	430	0 (0.3)	4.5E+01	3E-02
Design-Basis Earthquake and Fire (unfiltered)	1E-04	3.1E-01	2E-04	740	0 (0.4)	7.7E+01	5E-02
Tank Farm Pump Spill	7.7E-04	2.6E-09	2E-12	6.3E-06	0 (4E-09)	6.5E-07	4E-10

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than one fatality estimated.

Radiological consequences to involved workers from these accidents could be highly variable depending upon whether or not a worker were directly in the plume of immediately released material.

Non-Radiological (Chemical) Consequences – Continuing T Plant Activities. The Interim Safety Basis (Bushore 2001) does not contain an analysis of the potential consequences of accidents involving non-radiological constituents of waste streams. The non-radiological consequences of accidents at WRAP, presented previously (Section 5.11.1.1.3.2), are assumed to represent potential non-radiological consequences of continuing T Plant activities.

Non-Radiological (Chemical) Consequences – New Waste Processing Facility. Non-radiological consequences for the new waste processing facility have not been evaluated in detail. However, potential non-radiological impacts from accidents in the WRAP are assumed to be representative for potential

impacts from new waste processing facility activities. Potential impacts from accidents in the CWC and Low Level Burial Grounds (LLBGs) would likely be bounding for accidents in the modified T Plant Complex.

Industrial Accidents-Construction. Employment for the T Plant Complex modification would total 120 worker-years. Estimated health and safety impacts would be 10 total recordable cases, 3 lost workday cases, and 66 lost workdays.

Industrial Accidents-Operations. Direct operations staffing in the modified T Plant Complex would total 3,900 worker-years. Estimated health and safety impacts would be 100 total recordable cases, 42 lost workday cases, and 1,500 lost workdays.

5.11.1.2.3.3 Disposal – LLBGs

Disposal and storage of solid radioactive waste generated at the Hanford Site would continue in the HSW disposal facilities of the 200 West and 200 East Areas. Accidents involving the LLW and MLLW trenches were evaluated in the Solid Waste Burial Grounds Interim Safety Basis by Vail (2001c) and the Solid Waste Burial Grounds Interim Safety Analysis by Vail (2001b).

Radiological Consequences – LLW Trenches. The radiological consequences associated with the disposal of LLW (Cat 1, Cat 3, and GTC3) are addressed in this section. Non-radiological (chemical) consequences were not evaluated due to the nature of the waste.

Five credible accidents at the trenches were evaluated as part of the Interim Safety Basis (Vail 2001c) and the Interim Safety Analysis (Vail 2001b). They were a heavy equipment accident with fire, a heavy equipment accident without fire, a drum explosion, an explosion involving an ion-exchange module, and a seismic event. Two other accidents involving high-integrity containers (HICs)—a heavy equipment accident with fire and a seismic event—were also addressed.

These accidents were selected for analysis through a hazard identification and assessment process and have estimated annual frequencies of occurrence ranging from 4E-02 per year to 5.3E-04 per year, categorized as anticipated and unlikely, respectively. Accident consequences, shown in terms of both radiation dose and LCFs, are presented in Table 5.40.

The largest consequences to the MEI would be from a heavy equipment accident with fire involving the HICs. The MEI would receive a dose of about 0.39 rem and have a 2E-04 probability of a LCF. This accident also results in the largest consequences to the population, with one LCF.

The largest consequences to a non-involved worker would be from a heavy equipment accident with fire involving the HICs. The non-involved worker would receive a dose of about 210 rem and have an 1E-01 probability of an LCF.

Table 5.40. Radiological Consequences of Accidents at the Low-Level Waste Trenches

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[a]	Dose (person-rem)	Number LCFs[b]	Dose (rem)	Prob. LCF[a]
Heavy Equipment Accident with Fire	5.3E-04	0.027	2E-05	140	0 (0.08)	14	0.008
Heavy Equipment Accident without Fire	1.3E-02	0.0022	1E-06	11	0 (0.007)	1	0.0007
Drum Explosion	4.0E-02	0.049	3E-05	250	0 (0.2)	26	0.02
Explosion in Ion-Exchange Module	1.0E-02	0.019	1E-05	97	0 (0.06)	10	0.006
Seismic Event[c]	1.0E-03	0.016	1E-05	79	0 (0.05)	8.3	0.005
HIC Operations							
Heavy Equipment Accident with Fire	5.3E-04	0.39	2E-04	2000	1	210	0.1
Seismic Event	1.0E-03	0.045	3E-05	220	0 (0.1)	23	0.01

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.
(c) This estimate is based on a breach of 500 drums, which is a conservative estimate of the number of stacked, uncovered drums at the face of the waste trenches. (Vail 2001c) back-calculates the number of drums breached from the site radiological risk guideline for onsite worker dose and is not appropriate for this analysis.

Radiological Consequences – MLLW Trenches. The radiological consequences of five accidents at the MLLW trenches were evaluated as part of the Interim Safety Analysis (Vail 2001b). These accidents were a heavy equipment (for example, a bulldozer) accident with fire, a heavy equipment accident with no fire, a drum explosion, a seismic event, and a leachate collection system spray release. These accidents were selected for analysis through a hazard identification and assessment process. Estimated annual frequencies of occurrence range from 4.0E-02 per year for anticipated accidents to 1E-02 to 1E-04 per year for unlikely accidents. Accident consequences, shown in terms of both radiation dose and LCFs, are presented in Table 5.41.

The largest consequences to the MEI would be from a drum explosion. The MEI would receive a dose of about 4.9E-02 rem and have a 3E-05 probability of a LCF. This accident also results in the largest consequences to the population but no LCFs would be expected.

The largest consequences to a non-involved worker would also be from a drum explosion. The non-involved worker would receive a dose of about 26 rem and have a 2E-02 probability of an LCF.

Table 5.41. Radiological Consequences of Accidents at the MLLW Trenches

Accident	Estimated Annual Frequency	Offsite MEI		Offsite Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[a]	Dose (person-rem)	Number LCFs[b]	Dose (rem)	Prob. LCF[a]
Heavy Equipment Accident with Fire	5.4E-04	0.029	2E-05	140	0 (0.09)	14	0.008
Heavy Equipment Accident without Fire	1.3E-02	0.0022	1E-06	11	0 (0.007)	1.1	0.0007
Drum Explosion	4.0E-02	0.049	3E-05	240	0 (0.2)	26	0.02
Seismic Event[c]	1.0E-03	0.017	1E-05	83	0 (0.05)	9	0.005
Leachate Collection System Spray Release	Unlikely[d]	0.00048	3E-07	2.4	0 (0.001)	0.25	0.002

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than one fatality estimated.
(c) This estimate is based on a breach of 500 drums, which is a conservative estimate of the number of stacked, uncovered drums at the face of the waste trenches. (Vail 2001c) back-calculates the number of drums breached from the site radiological risk guideline for onsite worker dose and is not appropriate for this analysis.
(d) No frequency provided. Estimated at "unlikely" (1E-02 to 1E-04).

Non-Radiological (Chemical) Consequences. The quantity and form of hazardous constituents in the MLLW trenches are subject to land disposal restrictions and other regulations that are prescriptive in how mixed waste must be treated prior to emplacement. No organic chemicals would be present. The Interim Safety Analysis by Vail (2001b) evaluated four of the previous accidents for non-radiological consequences at the MLLW trenches, including the heavy equipment accident with fire, a heavy equipment accident with no fire, a drum explosion, and a seismic event. Chemicals were assumed to be at the maximum allowable concentrations and the waste was in bulk form (rather than in containers). Accident consequences are presented in Tables 5.42 through 5.45.

For all accidents, the air concentration at the location of the offsite MEI would be well below the TEEL/ERPG-1 level for all chemicals. No impacts would be expected. For the onsite non-involved worker, the TEEL/ERPG-3 levels could be reached or exceeded for three chemicals—molybdenum, nickel, and selenium—for the heavy equipment accident with fire and only selenium for the seismic event. A hypothetically exposed individual may experience or develop a life-threatening effect as a result of a one-hour exposure to any one of these chemicals. The TEEL/ERPG-2 levels would be exceeded for 16 chemicals for the heavy equipment accident with fire, and 13 chemicals for the seismic event. An individual might experience or develop irreversible or other serious health effects or symptoms that might impair the ability to take protective action.

Table 5.42. Non-Radiological Air Concentrations for a Heavy Equipment Accident with Fire at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	2.0E+02	3.9E-01	30	50	250	6.8	4.1	0.8	1.3E-02		
Antimony	1.0E+01	2.0E-02	1.5	2.5	50	6.8	4.1	0.2	1.3E-02		
Arsenic	2.0E-01	3.9E-04	0.03	1.4	5	6.8	0.15		1.3E-02		
Barium	1.0E+01	2.0E-02	1.5	2.5	12.5	6.8	4.1	0.8	1.3E-02		
Beryllium	1.0E-03	2.0E-06	0.005	0.025	0.1	0.2			4.0E-04		
Cadmium	4.1E-02	7.8E-05	0.03	4	9	1.4	0.01		2.6E-03		
Calcium hydroxide	1.0E+02	2.0E-01	15	25	500	6.8	4.1	0.2	1.3E-02		
Chromium	1.0E+01	2.0E-02	1.5	2.5	250	6.8	4.1	0.04	1.3E-02		
Cobalt	4.1E-01	7.8E-04	0.1	0.1	20	4.1	4.1	0.02	7.8E-03		
Copper	2.0E+01	3.9E-02	3	5	100	6.8	4.1	0.2	1.3E-02		
Iron oxide dust	1.0E+02	2.0E-01	15	25	500	6.8	4.1	0.2	1.3E-02		
Lead	1.0E+00	2.0E-03	0.15	0.25	100	6.8	4.1	0.01	1.3E-02		
Magnesium	1.0E+02	2.0E-01	30	50	250	3.4	2.0	0.4	6.5E-03		
Manganese	1.0E+02	2.0E-01	3	5	500	34	20	0.2	6.5E-02		
Mercury	2.1E-02	4.0E-05	0.025	0.1	10	0.8			1.6E-03		
Molybdenum	1.0E+02	2.0E-01	15	25	60	6.8	4.1	1.7	1.3E-02		
Nickel	2.0E+01	3.9E-02	4.5	10	10	4.5	2.0	2.0	8.7E-03		
Potassium hydroxide	4.1E-01	8.0E-04	2	2	150	0.2			4.0E-04		
Selenium	4.1E+00	7.8E-03	0.6	1	1	6.8	4.1	4.1	1.3E-02		
Silver	2.0E-01	3.9E-04	0.3	0.5	10	0.7			1.3E-03		
Sodium hydroxide	4.1E-01	8.0E-04	0.5	5	50	0.8			1.6E-03		
Thallium	2.0E+00	3.9E-03	0.3	2	15	6.8	1.0	0.1	1.3E-02		
Vanadium pentoxide	1.0E-01	2.0E-04	0.075	0.5	35	1.4	0.2		2.7E-03		
Zinc oxide	2.0E+02	3.9E-01	15	15	500	14	14	0.41	2.6E-02		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Table 5.43. Non-Radiological Air Concentrations for a Heavy Equipment Accident Without Fire at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1, (mg/m^3)	TEEL-2, (mg/m^3)	TEEL-3, (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	4.1E+00	7.8E-03	30	50	250	1.4E-01			2.6E-04		
Antimony	2.0E-01	3.9E-04	1.5	2.5	50	1.4E-01			2.6E-04		
Arsenic	4.1E-03	7.8E-06	0.03	1.4	5	1.4E-01			2.6E-04		
Barium	2.0E-01	3.9E-04	1.5	2.5	12.5	1.4E-01			2.6E-04		
Beryllium	2.1E-05	4.0E-08	0.005	0.025	0.1	4.2E-03			8.0E-06		
Cadmium	8.2E-04	1.6E-06	0.03	4	9	2.7E-02			5.2E-05		
Calcium hydroxide	2.0E+00	3.9E-03	15	25	500	1.4E-01			2.6E-04		
Chromium	2.0E-01	3.9E-04	1.5	2.5	250	1.4E-01			2.6E-04		
Cobalt	8.2E-03	1.6E-05	0.1	0.1	20	8.2E-02			1.6E-04		
Copper	4.1E-01	7.8E-04	3	5	100	1.4E-01			2.6E-04		
Iron oxide dust	2.0E+00	3.9E-03	15	25	500	1.4E-01			2.6E-04		
Lead	2.0E-02	3.9E-05	0.15	0.25	100	1.4E-01			2.6E-04		
Magnesium	2.0E+00	3.9E-03	30	50	250	6.8E-02			1.3E-04		
Manganese	2.0E+00	3.9E-03	3	5	500	6.8E-01			1.3E-03		
Mercury	4.2E-04	8.0E-07	0.025	0.1	10	1.7E-02			3.2E-05		
Molybdenum	2.0E+00	3.9E-03	15	25	60	1.4E-01			2.6E-04		
Nickel	4.1E-01	7.8E-04	4.5	10	10	9.1E-02			1.7E-04		
Potassium hydroxide	8.3E-03	1.6E-05	2	2	150	4.1E-03			8.0E-06		
Selenium	8.2E-02	1.6E-04	0.6	1	1	1.4E-01			2.6E-04		
Silver	4.1E-03	7.8E-06	0.3	0.5	10	1.4E-02			2.6E-05		
Sodium hydroxide	8.3E-03	1.6E-05	0.5	5	50	1.7E-02			3.2E-05		
Thallium	4.1E-02	7.8E-05	0.3	2	15	1.4E-01			2.6E-04		
Vanadium pentoxide	2.1E-03	4.0E-06	0.075	0.5	35	2.8E-02			5.3E-05		
Zinc oxide	4.1E+00	7.8E-03	15	15	500	2.7E-01			5.2E-04		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Table 5.44. Non-Radiological Air Concentrations for a Drum Explosion at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	9.3E+00	1.8E-02	30	50	250	3.1E-01			5.9E-04		
Antimony	4.6E-01	8.9E-04	1.5	2.5	50	3.1E-01			5.9E-04		
Arsenic	9.3E-03	1.8E-05	0.03	1.4	5	3.1E-01			5.9E-04		
Barium	4.6E-01	8.9E-04	1.5	2.5	12.5	3.1E-01			5.9E-04		
Beryllium	4.7E-05	9.1E-08	0.005	0.025	0.1	9.4E-03			1.8E-05		
Cadmium	1.9E-03	3.6E-06	0.03	4	9	6.2E-02			1.2E-04		
Calcium hydroxide	4.6E+00	8.9E-03	15	25	500	3.1E-01			5.9E-04		
Chromium	4.6E-01	8.9E-04	1.5	2.5	250	3.1E-01			5.9E-04		
Cobalt	1.9E-02	3.6E-05	0.1	0.1	20	1.9E-01			3.6E-04		
Copper	9.3E-01	1.8E-03	3	5	100	3.1E-01			5.9E-04		
Iron oxide dust	4.6E+00	8.9E-03	15	25	500	3.1E-01			5.9E-04		
Lead	4.6E-02	8.9E-05	0.15	0.25	100	3.1E-01			5.9E-04		
Magnesium	4.6E+00	8.9E-03	30	50	250	1.5E-01			3.0E-04		
Manganese	4.6E+00	8.9E-03	3	5	500	1.5E+00	0.9		3.0E-03		
Mercury	9.4E-04	1.8E-06	0.025	0.1	10	3.8E-02			7.3E-05		
Molybdenum	4.6E+00	8.9E-03	15	25	60	3.1E-01			5.9E-04		
Nickel	9.3E-01	1.8E-03	4.5	10	10	2.1E-01			4.0E-04		
Potassium hydroxide	1.9E-02	3.6E-05	2	2	150	9.4E-03			1.8E-05		
Selenium	1.9E-01	3.6E-04	0.6	1	1	3.1E-01			5.9E-04		
Silver	9.3E-03	1.8E-05	0.3	0.5	10	3.1E-02			5.9E-05		
Sodium hydroxide	1.9E-02	3.6E-05	0.5	5	50	3.8E-02			7.3E-05		
Thallium	9.3E-02	1.8E-04	0.3	2	15	3.1E-01			5.9E-04		
Vanadium pentoxide	4.7E-03	9.1E-06	0.075	0.5	35	6.3E-02			1.2E-04		
Zinc oxide	9.3E+00	1.8E-02	15	15	500	6.2E-01			1.2E-03		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Table 5.45. Non-Radiological Air Concentrations for a Seismic Event Without Fire at the LLBGs

	Onsite Worker Conc. (mg/m^3)	Offsite MEI Conc. (mg/m^3)	TEEL-1 (mg/m^3)	TEEL-2 (mg/m^3)	TEEL-3 (mg/m^3)	Onsite[(a)] TEEL-1 Ratio	Onsite TEEL-2 Ratio	Onsite TEEL-3 Ratio	Offsite[(b)] TEEL-1 Ratio	Offsite TEEL-2 Ratio	Offsite TEEL-3 Ratio
Aluminum	7.4E+01	1.4E-01	30	50	250	2.5	1.5	0.3	4.8E-03		
Antimony	3.7E+00	7.1E-03	1.5	2.5	50	2.5	1.5	0.07	4.8E-03		
Arsenic	7.4E-02	1.4E-04	0.03	1.4	5	2.5	0.05		4.8E-03		
Barium	3.7E+00	7.1E-03	1.5	2.5	12.5	2.5	1.5	0.3	4.8E-03		
Beryllium	3.8E-04	7.3E-07	0.005	0.025	0.1	0.08			1.5E-04		
Cadmium	1.5E-02	2.9E-05	0.03	4	9	0.5			9.5E-04		
Calcium hydroxide	3.7E+01	7.1E-02	15	25	500	2.5	1.5	0.1	4.8E-03		
Chromium	3.7E+00	7.1E-03	1.5	2.5	250	2.5	1.5	0.01	4.8E-03		
Cobalt	1.5E-01	2.9E-04	0.1	0.1	20	1.5	1.5	7.4E-03	2.9E-03		
Copper	7.4E+00	1.4E-02	3	5	100	2.5	1.5	0.07	4.8E-03		
Iron oxide dust	3.7E+01	7.1E-02	15	25	500	2.5	1.5	0.1	4.8E-03		
Lead	3.7E-01	7.1E-04	0.15	0.25	100	2.5	1.5	0.004	4.8E-03		
Magnesium	3.7E+01	7.1E-02	30	50	250	1.2	0.7		2.4E-03		
Manganese	3.7E+01	7.1E-02	3	5	500	12	7.4	0.07	2.4E-02		
Mercury	7.6E-03	1.5E-05	0.025	0.1	10	0.3			5.8E-04		
Molybdenum	3.7E+01	7.1E-02	15	25	60	2.5	1.5	0.6	4.8E-03		
Nickel	7.4E+00	1.4E-02	4.5	10	10	1.6	0.7		3.2E-03		
Potassium hydroxide	1.5E-01	2.9E-04	2	2	150	0.08			1.5E-04		
Selenium	1.5E+00	2.9E-03	0.6	1	1	2.5	1.5	1.5	4.8E-03		
Silver	7.4E-02	1.4E-04	0.3	0.5	10	0.2			4.8E-04		
Sodium hydroxide	1.5E-01	2.9E-04	0.5	5	50	0.3			5.8E-04		
Thallium	7.4E-01	1.4E-03	0.3	2	15	2.5	0.4		4.8E-03		
Vanadium pentoxide	3.8E-02	7.3E-05	0.075	0.5	35	0.5			9.7E-04		
Zinc oxide	7.4E+01	1.4E-01	15	15	500	5	5	0.15	9.5E-03		

(a) Onsite = non-involved worker.
(b) Offsite = offsite MEI.

Radiological Consequences – ILAW Disposal. The radiological consequences associated with the disposal of ILAW (as MLLW) in a new disposal facility near the PUREX Plant are addressed in this section. There would be no non-radiological (chemical) consequences due to the processing and physical form of the waste, so non-radiological impacts were not evaluated.

A preliminary hazards assessment (Burbank 2001) identified 198 hazardous conditions grouped into 15 accident categories; quantitative results were reported for two accidents. A bulldozer accident was assumed to occur and shear off the tops of six ILAW containers. A crane accident had the crane falling into a trench with the boom striking an exposed container array 10 packages wide by 5 packages wide. Accident consequences, shown in terms of both radiation dose and LCF, are presented in Table 5.46.

Table 5.46. Radiological Consequences of Accidents Involving ILAW Disposal

Accident	Estimated Annual Frequency	Offsite MEI		Population		Non-Involved Worker	
		Dose (rem)	Prob. LCF[(a)]	Dose (person -rem)	Number LCFs[(b)]	Dose (rem)	Prob. LCF[(a)]
Bulldozer Accident	N/A	1.9E-05	1E-08	5.0E-02	3E-05	2.3E-02	1E-05
Crane Accident	N/A	3.4E-05	2E-08	9.0E-02	5E-05	4.3E-02	3E-05

(a) Prob. LCF = the probability of a latent cancer fatality in the hypothetically exposed individual.
(b) Number LCFs = the number of latent cancer fatalities in the hypothetically exposed population. Probability indicated in parentheses if less than 1 fatality estimated.

The largest consequences to the MEI would be from the crane accident. The MEI would receive a dose of about 3E-05 rem and have a 2E-08 probability of an LCF. This accident also results in the largest consequences to the population, with about a 5E-05 probability of an LCF.

The largest consequences to workers would also be from the crane accident. The non-involved worker would receive a dose of about 0.04 rem and have a 3E-05 probability of an LCF.

LLBGs Industrial Accidents. This section addresses potential health and safety impacts from construction and operation of LLW and MLLW trenches and supporting facilities (pulse driers) in the LLBGs. Estimated health and safety impacts from construction and operation of MLLW trenches are included in totals for the LLBGs presented below.

LLBGs Industrial Accidents-Construction. Construction of new trenches and pulse driers for MLLW trenches would require a total of 7 to 10 worker-years. The estimated health and safety impacts would be less than one total recordable case, less than one lost workday cases.

LLBGs Industrial Accidents-Operations. Direct operations staffing in the LLBGs would total 3800 worker-years. Estimated health and safety impacts would be 100 total recordable cases, 42 lost workday cases, and 1500 lost workdays.

ILAW Industrial Accidents. Industrial impacts are not separated by construction and operations. A total of about 5,000 worker-years would be required for construction, operations, and closure. The